RETURN ON GRADUATE EDUCATION INVESTMENT

Prof. William R. Bowman
Economics Department, USNA
and
Prof. Stephen L. Mehay
School of Business and Public Policy, NPS

February, 2002

REQUIREMENT FOR COST-BENEFIT ANALYSIS

- **OMB requires executive branch agencies to conduct economic analysis of programs**
- **Economic costs and benefits are basis for estimating return on investment (ROI)**
- **Cost-Benefit Analysis (CBA) guidelines provided in *OMB Circular A-94***
- **Prior studies of Navy's graduate education program have not conducted CBA, or followed OMB guidelines**

Analysis of ROI for Graduate Education

- ***OBJECTIVE:*** **Develop a cost-benefit analysis of Navy's funded graduate education program**
  - **Compare funded program to two alternatives:**
    - Off duty graduate degree
    - No graduate degree
- ***EXAMPLE:*** **Use data on Surface Warfare Officers**
- ***APPROACH:*** **Use accepted economic principles to estimate monetary values of program benefits and costs**

Valuing benefits of graduate education

Program Outcomes	*Benefits to Navy*	*Monetary Benefits*
I. *Increased retention*	**--Reduced accessions**	**--Reduced accession costs and post-accession training costs;** **--Reduced bonuses**
II. *Increased labor productivity* **--In sub-specialty**	**--Increased output/readiness** **--Reduced**	**--Reduced manpower costs**

Valuing benefits -- II

Output	*Benefit*	*Monetary value*
III. *Increased equipment productivity*	**--Increased output/readiness**	**--Reduced equipment costs**
IV. *Increased team/unit productivity*	**--Increased output/readiness** **--Reduced manpower**	**--Reduced manpower costs**
V. *Student/Faculty Research output*	**--Research projects/output**	**--Improved operations;** **--Reduced operation costs**

Valuing Benefits -- III

Output	Benefit	Monetary Value
VI. Increased QOL; job and Navy satisfaction	**--Increased retention (indirect effect)**	**--Reduced accession and bonus costs**

Approach

- **Our CBA approach includes <u>all costs</u>, but only <u>some benefits</u>**
- **Of the 6 potential benefits listed above, we measure only 2:**
  - **Retention benefits**
    - Use data on SWO officers
  - **Productivity benefits**
    - Use data from labor market studies of wage differentials for M.A. degrees

Approach -- II

- **Therefore, the CBA deliberately <u>understates net benefits</u> of the funded graduate program**
- **If estimated net benefits are positive, we can be more confident in robustness of net benefits**

RETENTION ANALYSIS

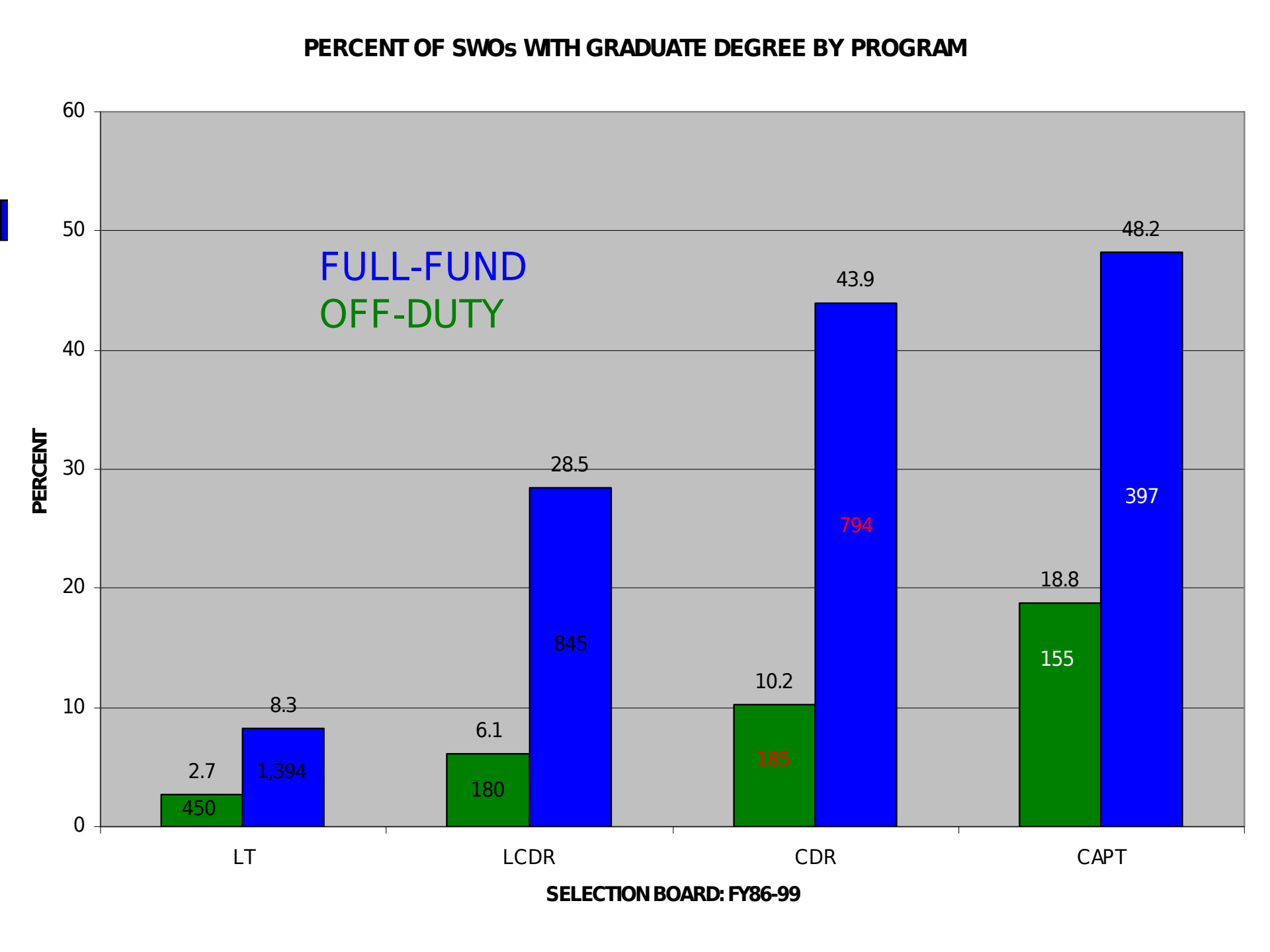
- **Use data on career progression of Surface officers from LT through CAPT**
- **Stratify SWO's by graduate degree type:**
  - **Fully-funded degree**
  - **Off-duty degree**
  - **No degree**
- **Simulate retention and promotion patterns of SWO's by degree type**

RETENTION ANALYSIS-II

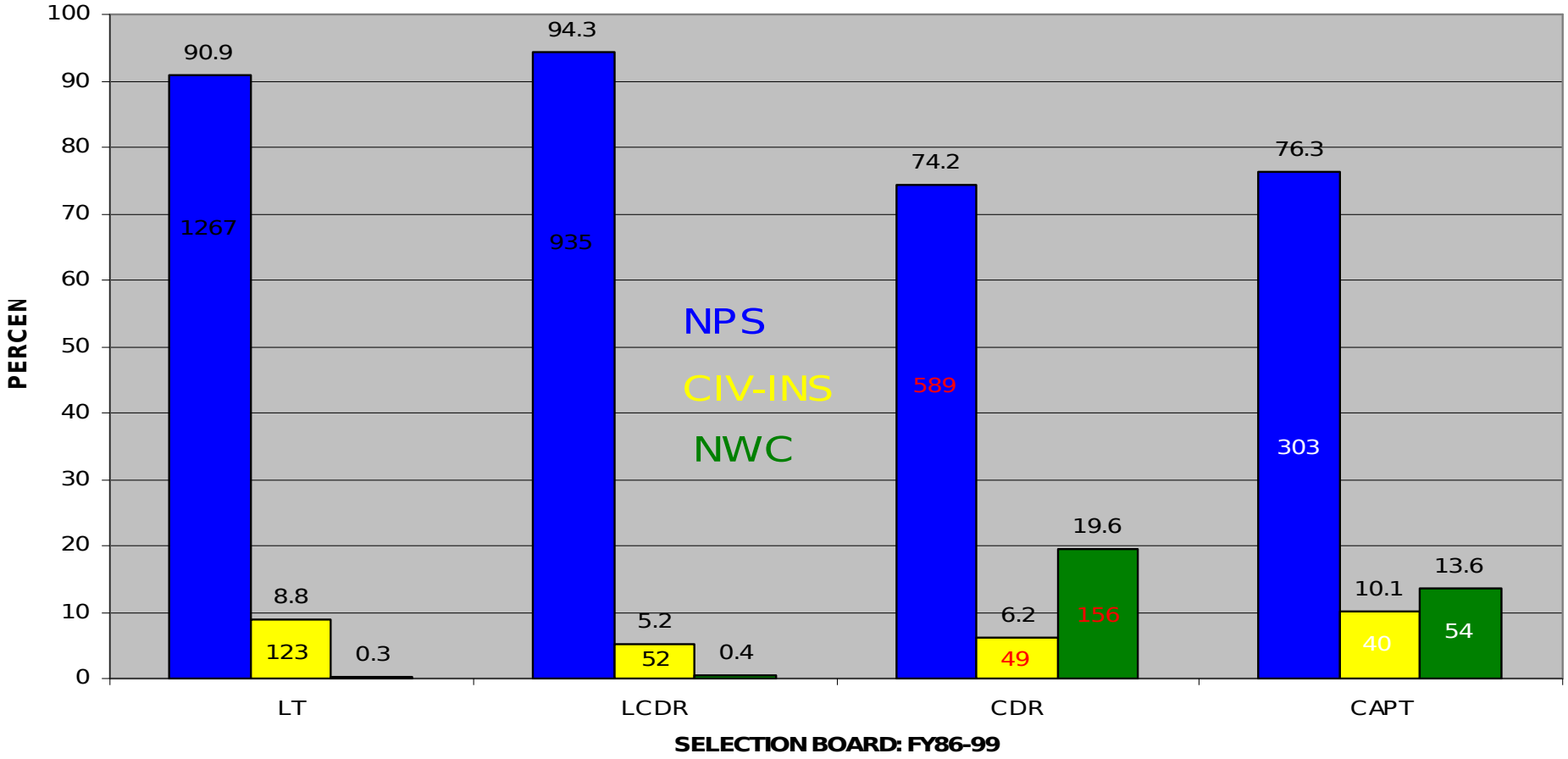
- **Retention/promotion differences yield estimates of steady-state accessions needed to produce one ‘career’ officer (CAPT)**
- **Lower commissioning and training costs are linked to the degree programs that improve accessions and reduce accessions**
- **The reduction in replacement costs represents the retention benefits of the funded graduate program**

Data

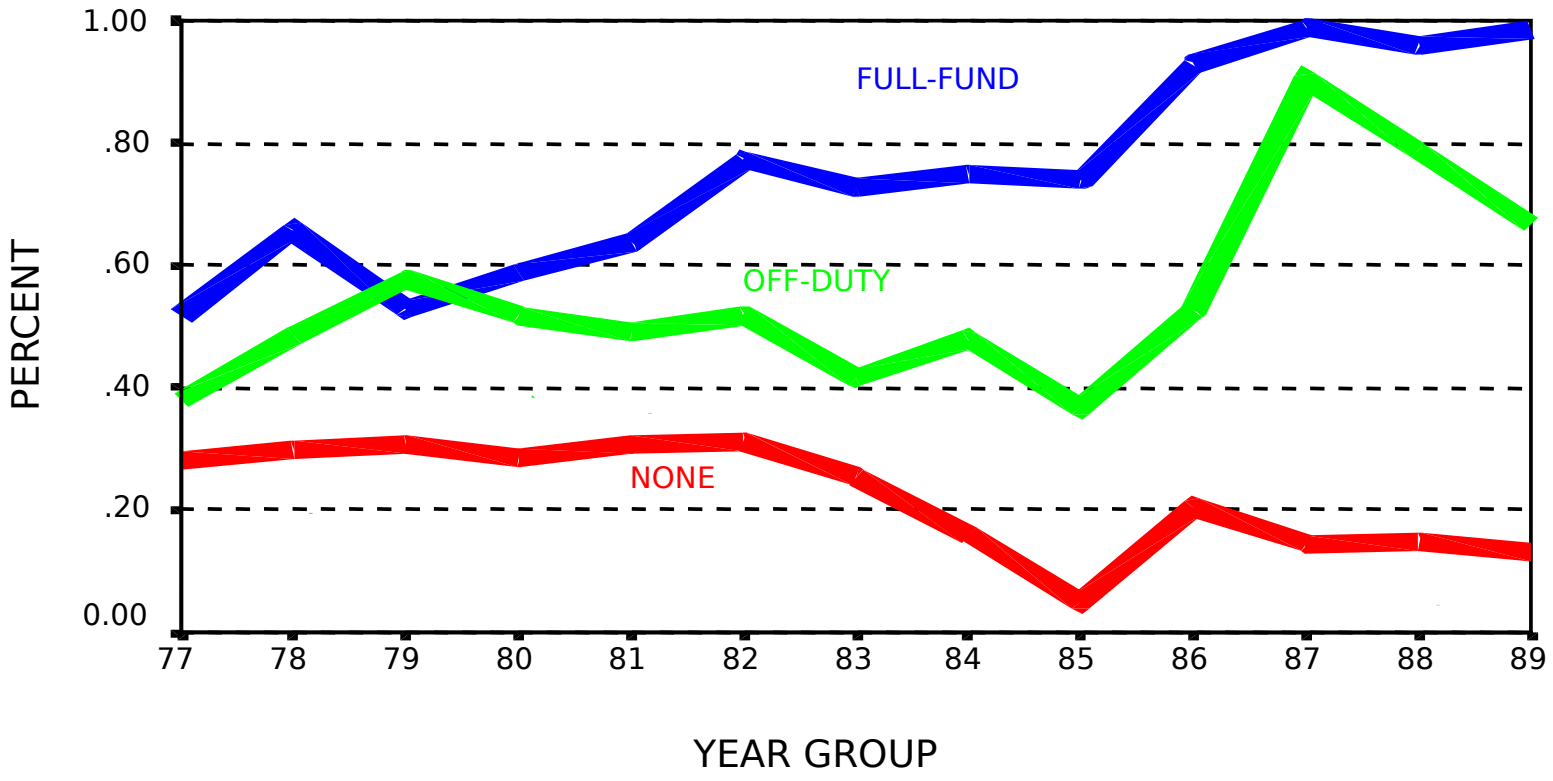
- **BUPERS Promotion History Files**
- **Year groups 1977-1989**
- **Data covers all promotion boards, all ranks, 1981-2000 (N=33,000+)**
- **Represents quasi-cohort (longitudinal) data**


PERCENT OF SWOs WITH GRADUATE DEGREE BY PROGRAM
60
50
40
30
20
10
0
PERCENT
FULL-FUND
OFF-DUTY
2.7
450
8.3
1,394
6.1
180
28.5
845
10.2
185
43.9
794
18.8
155
48.2
397
LT
LCDR
CDR
CAPT
SELECTION BOARD: FY86-99

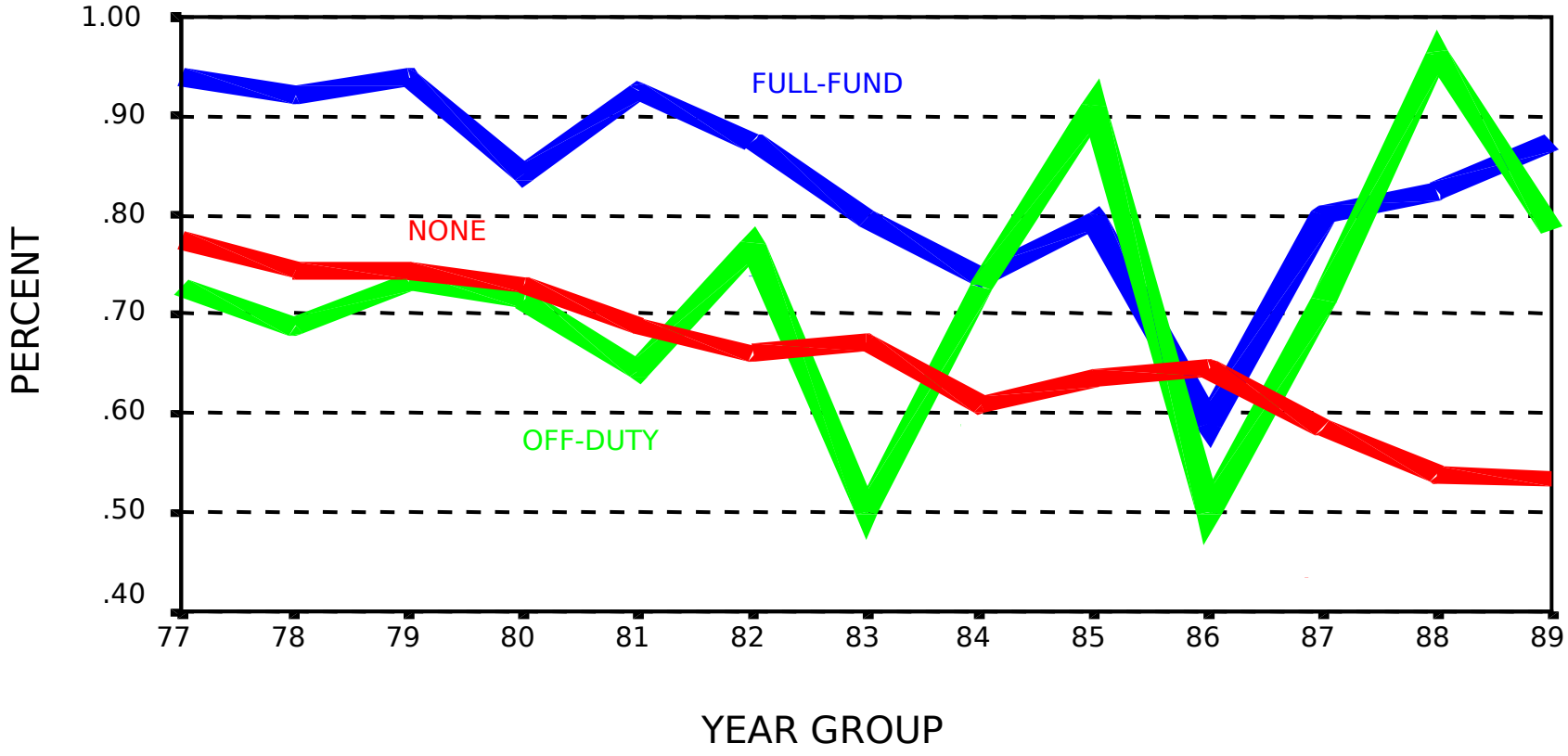
COMPOSITION OF FULLY- FUNDED GRADUATE DEGREE PROGRAM OF SWOs AT SELECTION BOARD



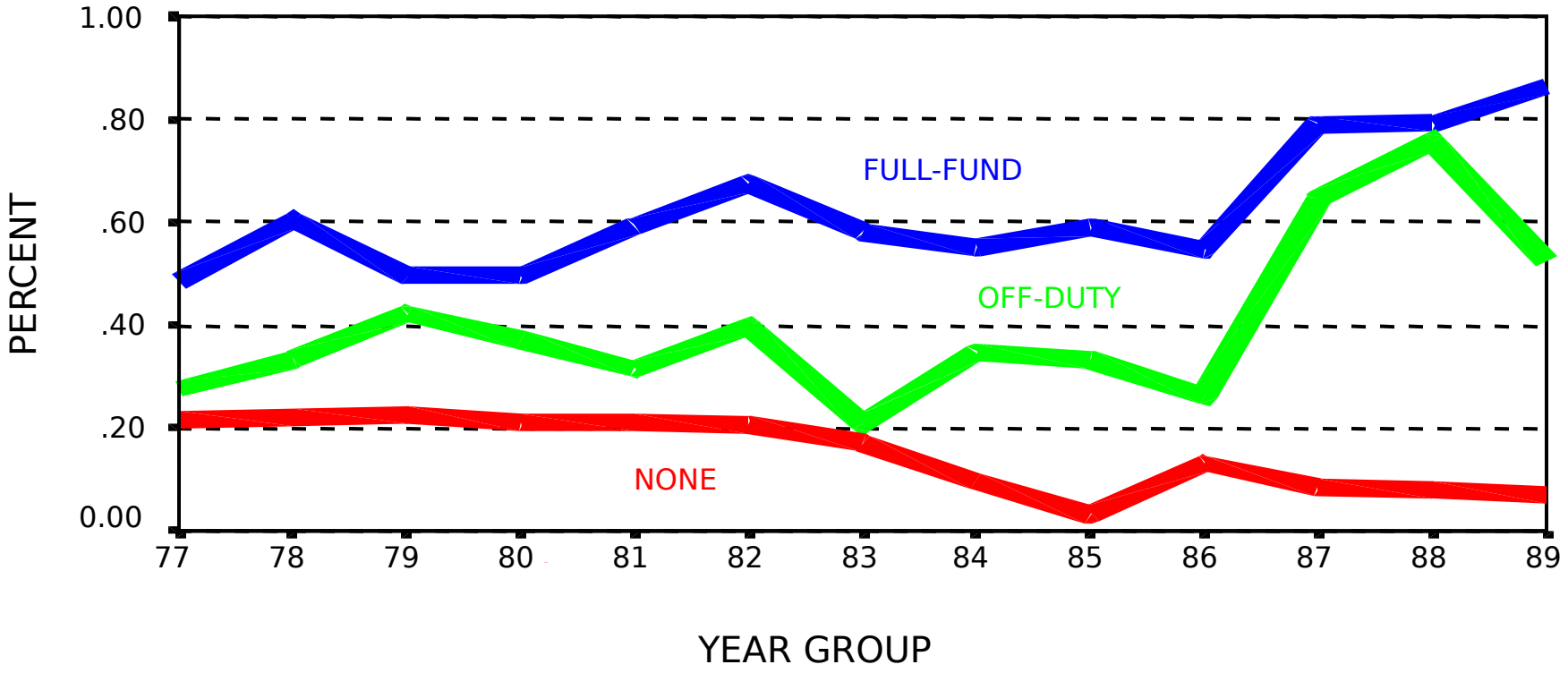
SWO RETENTION RATES TO O4 BY GRADUATE DEGREE



SWO PROMOTION RATES TO O4 BY GRADUATE DEGREE

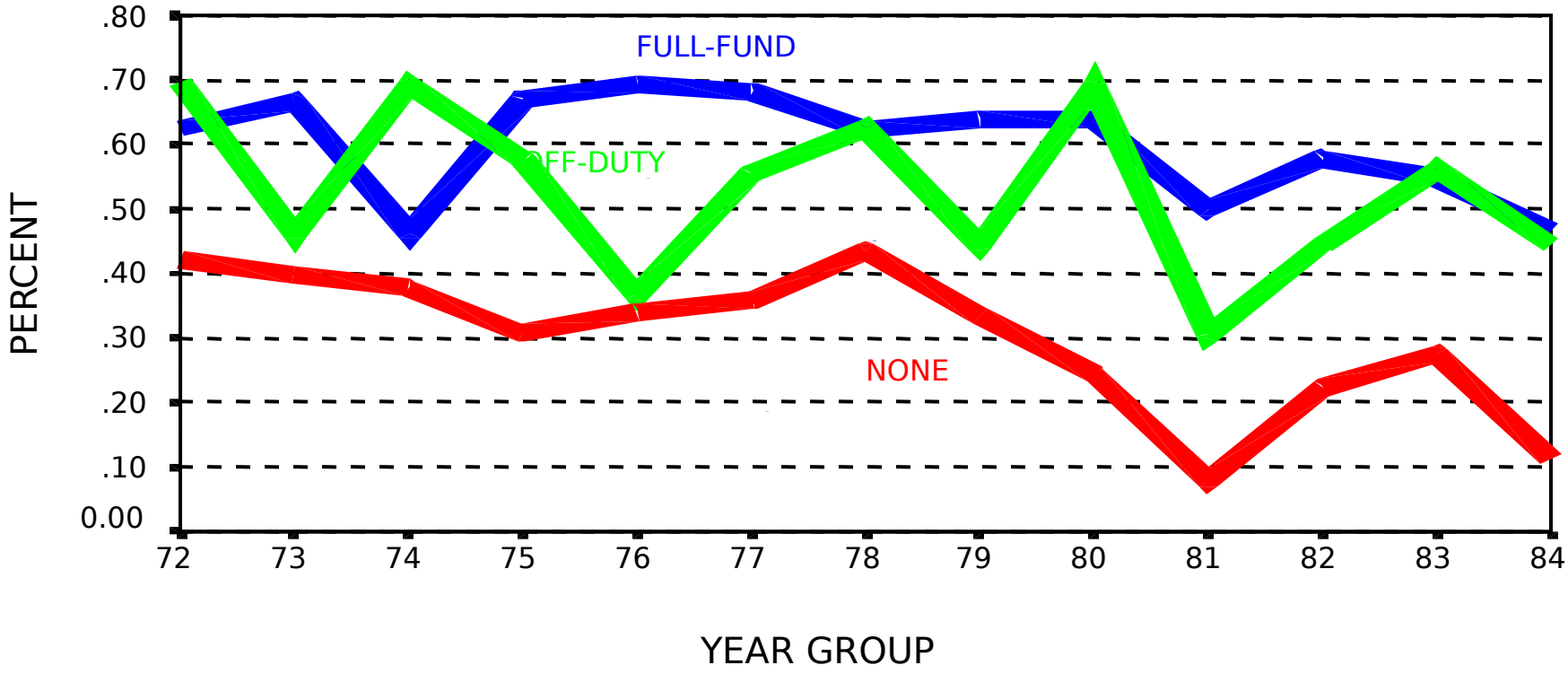


O4 "YIELD RATES“ OF SWO’s BY GRADUATE DEGREE



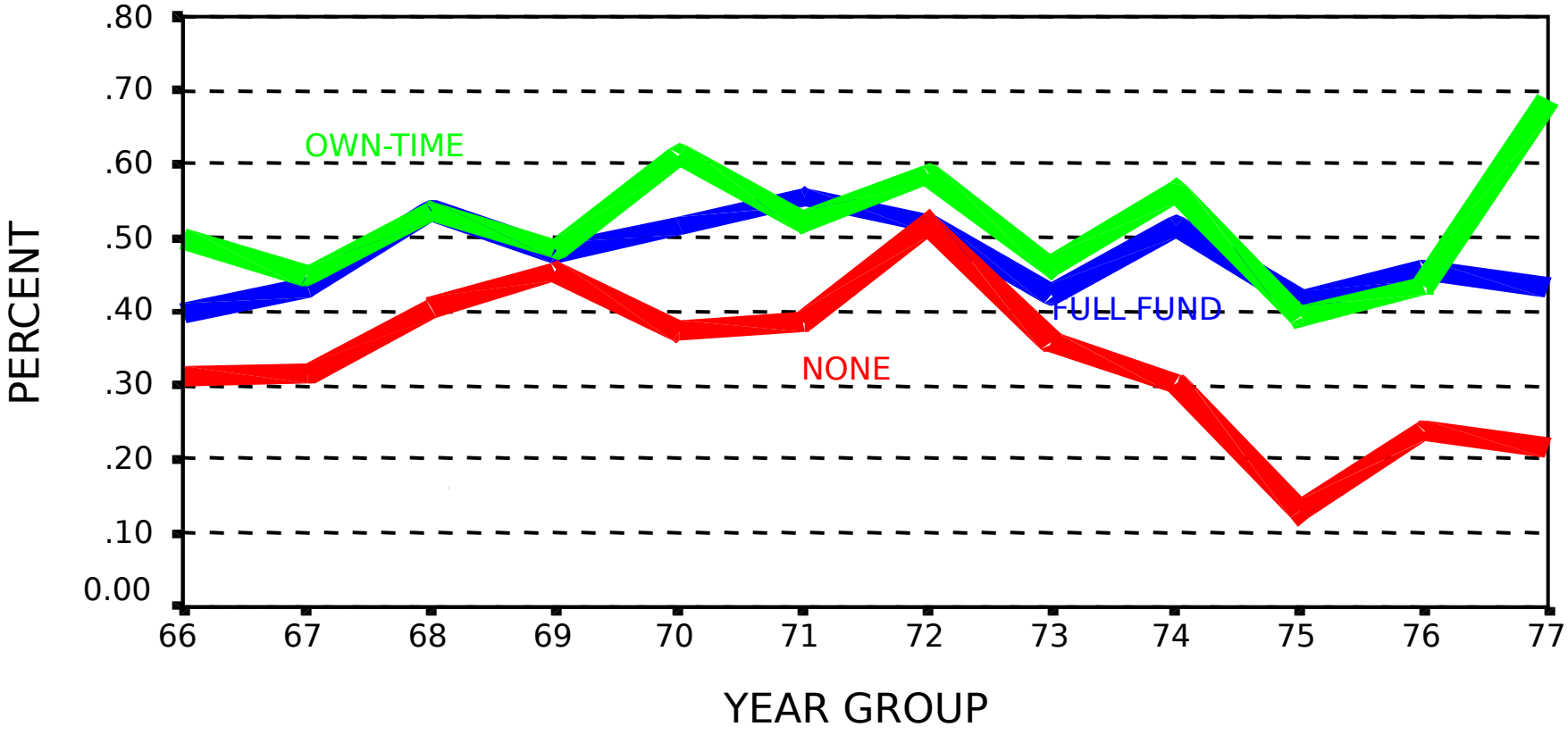
Yield Rate=Percent of Ensigns who stay to 04 board and promote.

O5 "YIELD RATES" BY GRADUATE DEGREE



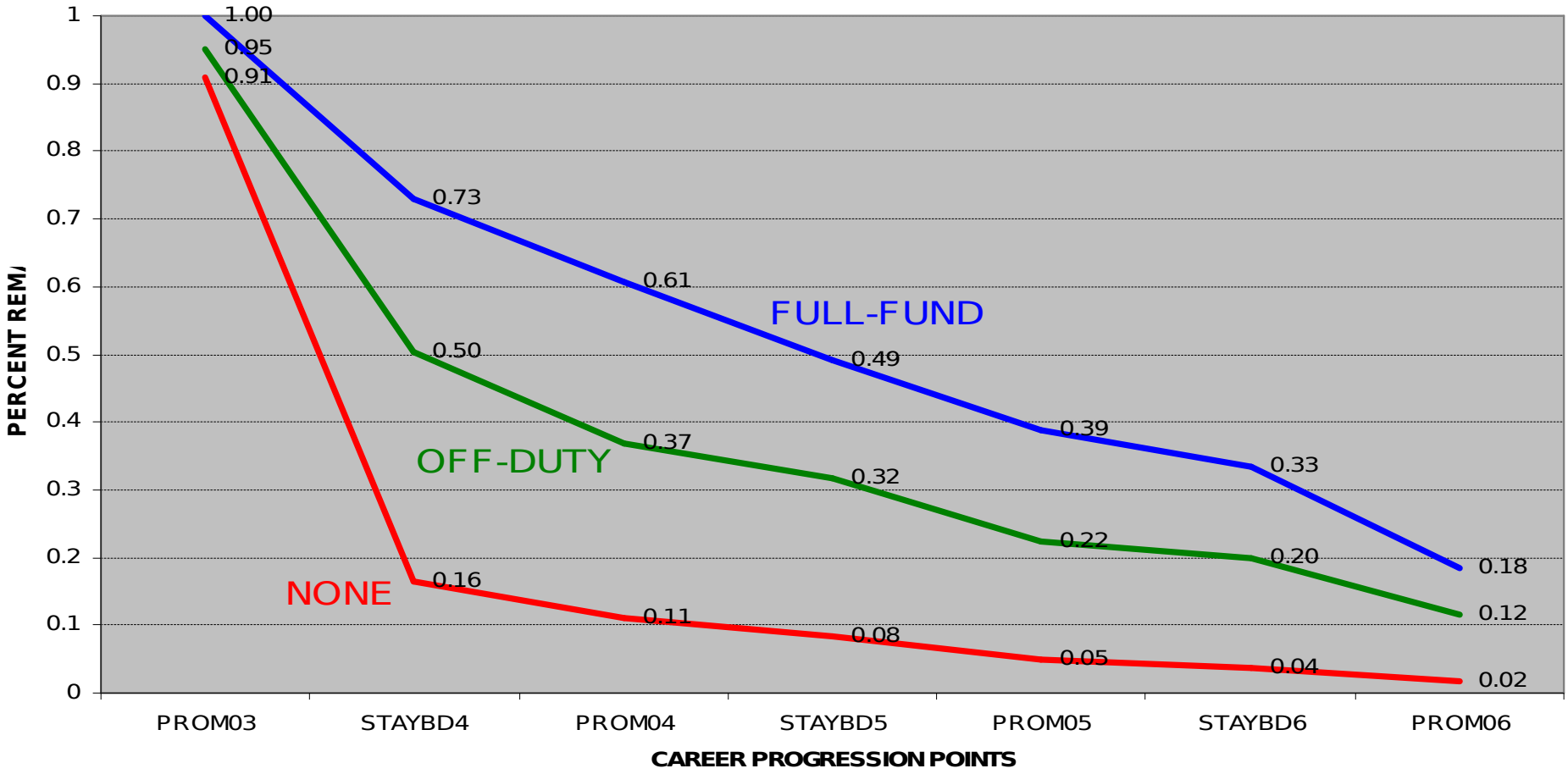
Yield Rate=Percent of LCDRs who stay and promote to Commander.

O6 "YIELD RATES" BY GRADUATE DEGREE

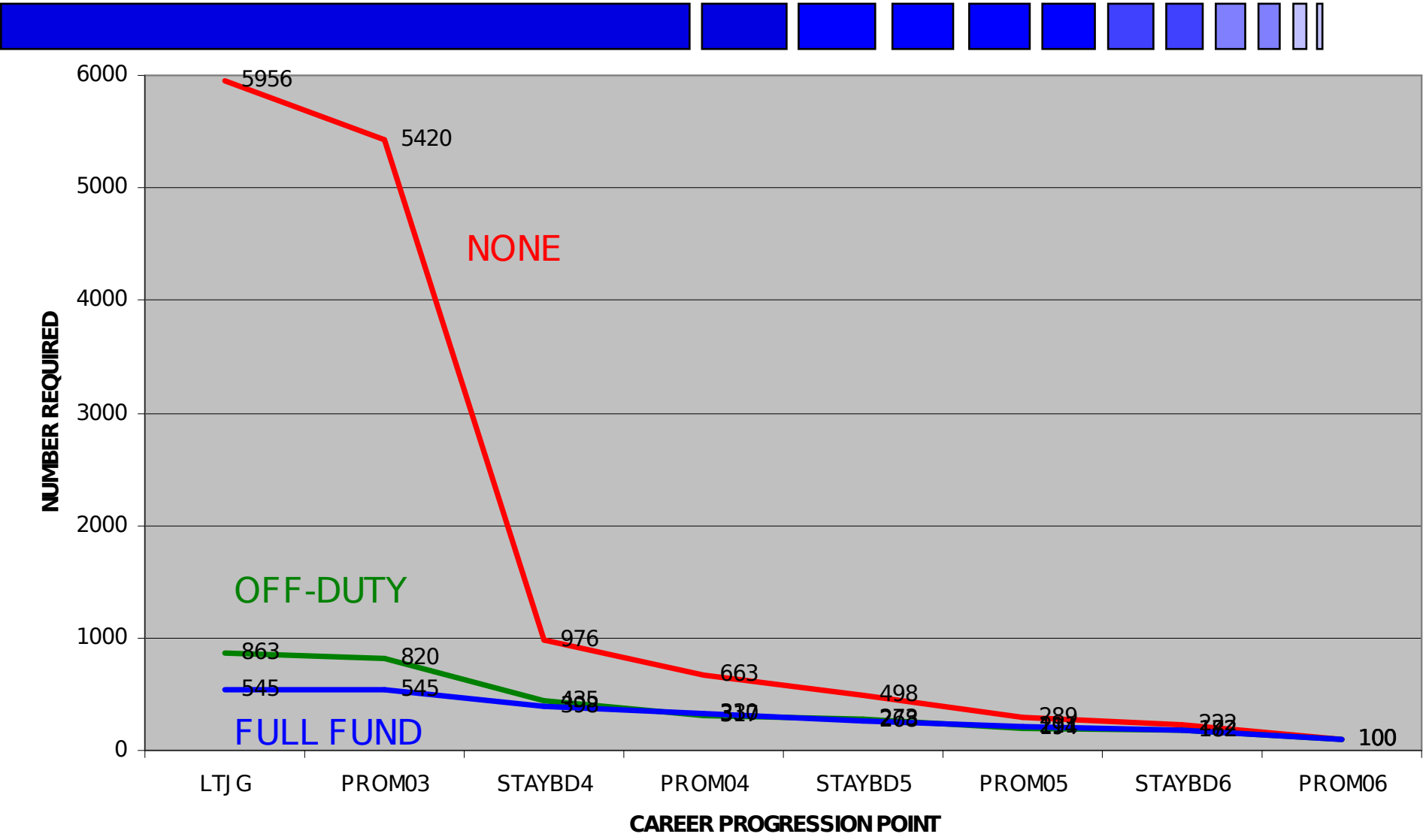


Yield Rate=Percent of CDRs who stay and promote to Captain.

AVERAGE CAREER PROGRESSION OF SURFACE WARFARE OFFICERS BY GRADUATE DEGREE STATUS: FY1986-1999



SIMULATED NUMBERS OF SURFACE WARFARE OFFICERS TO YIELD 100 CAPTAINS BY GRADUATE DEGREE STATUS



Monetary value of retention benefits

- **Commissioning costs avoided**

= $\sum_i$ (reduced accessions)^a

x (commissioning costs per accession$_i$)}

where i = commission source (USNA, NROTC, OCS)

^{a}Accessions saved =

(accessions to produce one CAPT via off-duty program)
- (accessions to produce one CAPT via funded program)

Retention Benefits

Program	(1) Difference in accessions	*(2) **BENEFITS:** Accession Costs Avoided*	(3) **COSTS:** Funded Graduate Education Program	(4) Net Benefits= (2)-(3)	(5) ROI= (4)/(3) x 100
No Grad. Educ.	**+5,411**	***$925.8 mil.***			
Off Duty Degree	**+318**	***$54.2 mil.***			

Costs of Funded Program

- **Program Costs:**
  - **Analyze marginal costs**
  - **For fully funded program:**
    - Include direct and indirect costs of NPS (or tuition at CIVINS)
    - Include student salaries
  - **In comparing funded to off-duty education:**
    - Deduct tuition assistance costs

Net Retention Benefits (of funded program)

Alternative Program	(1) Difference in accessions	(2) **BENEFITS:** Accession Costs Avoided	(3) **COSTS:** Funded Graduate Education Program	*(4) Net Benefits = (2)-(3)*	(5) ROI= (4)/(3) x 100
No Grad. Educ.	**+5,411**	**$925.8 mil.**	**$66.8 mil**	***+$859 mil.***	**1208%**
Off Duty Degree	**+318**	**$54.2 mil.**	**$52.3 mil.** (net of TA)	***+$1.9 mil.***	**3.6%**

Preliminary Results

- **Large positive net economic benefits for funded degree program vs. no degree**
- **However, net benefits for funded degree vs. off-duty program are positive, but small**
  - **Thus, we must explore robustness of net benefit estimates for funded vs. off-duty degrees**

Productivity Effects of Graduate Education

- **Primary purpose of funded program is to supply sub-specialists to p-coded billets**
  - **= specific utilization benefits**
- **Also, theory of investment in human capital implies that productivity benefits will accrue to M.A. holders serving in other billets**
  - **= general productivity benefits**

Valuing the Productivity Effects

- **Standard approach in CBA is to use labor market studies of degree-related wage differentials**
- **Approach is based on the higher wage that firms pay workers with advanced degrees**
- **Yields imputed value of education in enhancing worker productivity**

Link between education and productivity

- **More educated workers are characterized by:**
  - **steeper learning curves**
  - **comparative advantage in implementing new technology**
  - **ability to deal with uncertainty in work environment**

- *Source: Bartel & Lichtenberg, “The Comparative Advantage of Educated Workers in Implementing New Technology,” *Review of Economics and Statistics*, 1987.

Productivity Effects -- I

- **Literature review finds rate of return to M.A. varies between 7%-20%, depending on major**
- **Rate of return estimates are based on earnings differences**
- **Competitive labor market model demonstrates that a worker's earnings reflect expected marginal product**

Other Evidence on Productivity Effects

- **Recent study of civilian DoD professional and technical employees finds:**
  - **Annual earnings 5%-9% higher for M.A.’s**
  - **M.A.’s 5% more likely to be promoted**
  - **M.A.’s 9% more likely to receive ‘top’ performance ratings**

Productivity effects--II

- **Highest rate of return for technical degrees -- engineering, science, computer science, ops research, for example**
- **Majority of degrees (64%) from Navy's funded program are technical**
- **Majority (81%) of off-duty degrees are non-technical**

Return to Funded Technical Degrees

- **Average rate of return to a civilian technical degree is nearly double that of a non-technical degree**
- **We apply this weighted average ROR differential (7%-points) to the productivity difference between officers with funded degrees vs. those with off-duty degrees**

Monetary Value of Productivity Benefits — Funded vs. Off-Duty Education

- **Multiply differential in return between technical and non-technical degree (7%) to officer's salary (Military Composite Standard Pay Rate) at each grade (O3-O5)**
  - **Annual general productivity benefit is $7.2 million**
  - **Multiply by average number of officers with M.A.'s who serve in each grade**

Monetary Value of Productivity Benefits — Funded vs. Off-Duty Education

- ✓ **Multiply differential in return between technical and non-technical degree (7%) to officer's salary (Military Composite Standard Pay Rate) at each grade (O3-O5)**
- ✓ **Multiply by average number of officers with M.A.'s who serve in each grade**
- ✓ **Annual general productivity benefit=$7.2 million**

Net Benefits and ROI—Funded v. Off-Duty Programs

Program	(1) Accession Benefit (costs avoided)	*(2) Productivity Benefit*	(3) Funded Education Program Costs	*(4) Net Benefits = (1+2)-(3)*	(5) ROI= (4)/(3) x 100
Off-duty vs. Funded Grad. Educ.	**$54.2 mil.**	***$7.2 mil.***	**$52.3 mil**	***+$9.1 mil.***	**17.4%**

Sensitivity Analysis

- **Sensitivity analysis tests robustness of net benefits by applying different assumptions/parameters**
- **For example, suppose ROR difference between funded and off-duty program is only 5%-points**
- **Provides lower-bound estimate of net benefits**

Sensitivity Analysis—Funded v. Off-Duty Programs

Program	(1) Accession Benefit (costs avoided)	*(2) Productiv-ity Benefit*	(3) Funded Education Program Costs	*(4) Net Benefits = (1+2)-(3)*	(5) ROI= (4)/(3) x 100
Off-duty vs. Funded Grad. Educ.	**$54.2 mil.**	***$5.1 mil.***	**$52.3 mil**	***+$7.0 mil.***	**13.3%**

Result of Sensitivity Analysis

- **Net benefits of funded degree appear to be robust – ROI is 13.3%**
- **Net benefit is not robust only if:**
  - **there is NO productivity difference and no other positive effects of funded degree**

CONCLUSIONS

- **Study performs CBA of Navy's funded graduate education following OMB guidelines**
- **Simulation suggests standard CBA techniques can be applied successfully and ROI can be estimated**

Conclusions -- II

- **CBA deliberately understates net benefits of funded program**
  - **Includes all costs**
  - **But includes only partial benefits**
- **Study finds positive net benefits**
- **ROI to funded program exceeds that to off-duty program**
- **Sensitivity analysis confirms robustness of net benefit estimates**

Future Refinements

- **Apply ROI to other communities;**
  - **Expect larger net benefits in STAFF/RL, but smaller net benefits in SUB and AVIATION.**
  - **On average, SWOs may be representative of Navy**
- **Monetize other benefits, such as those from utilization of p-coded officers**

Refinements -- II

- **Evaluate non-tangible benefits:**
  - **Funded program can stress military-specific applications**
  - **Funded program can direct students into specific areas of study (such as engineering, science)**

Refinements -- III

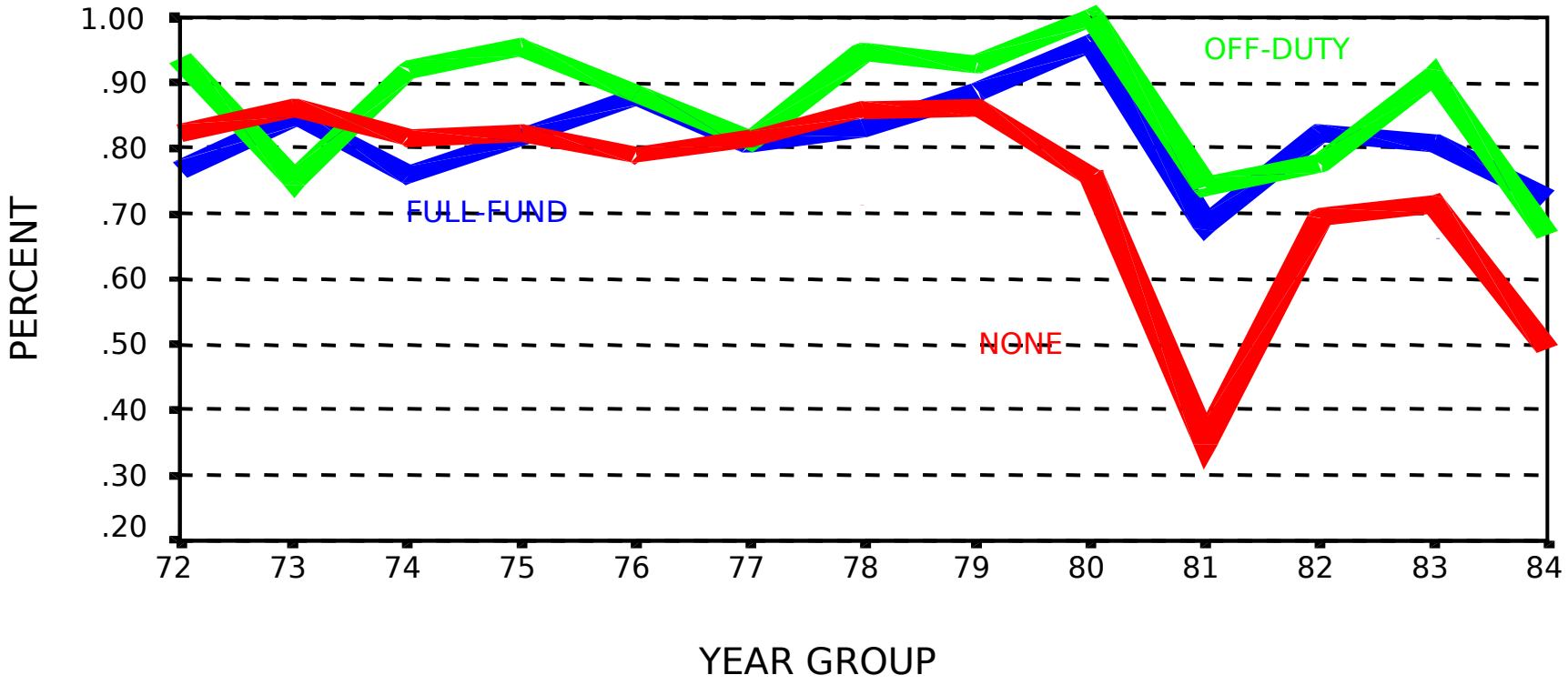
- **Officer accession reductions occur over time**
  - **Evaluate dynamic flow of officer accessions and compute present value of cost savings**
- **Similarly, graduate program delivered over time**
  - **Compute present value of program costs**

Refinements -- IV

- **Post-commissioning training costs differ by community and should be included in retention analysis**
- **These costs are also reduced when retention increases**

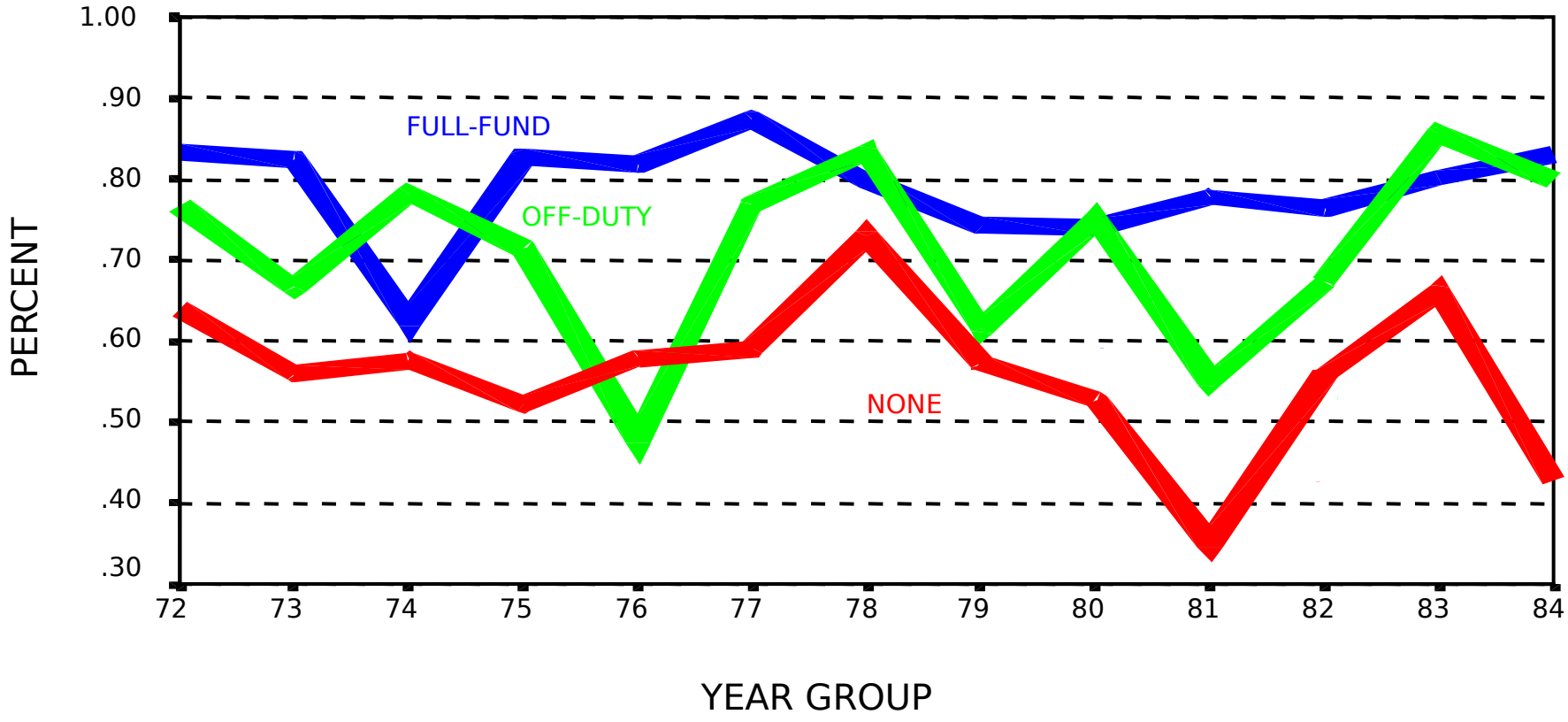
Back-up Slides

SWO RETENTION RATES TO CDR BY GRADUATE DEGREE STATUS

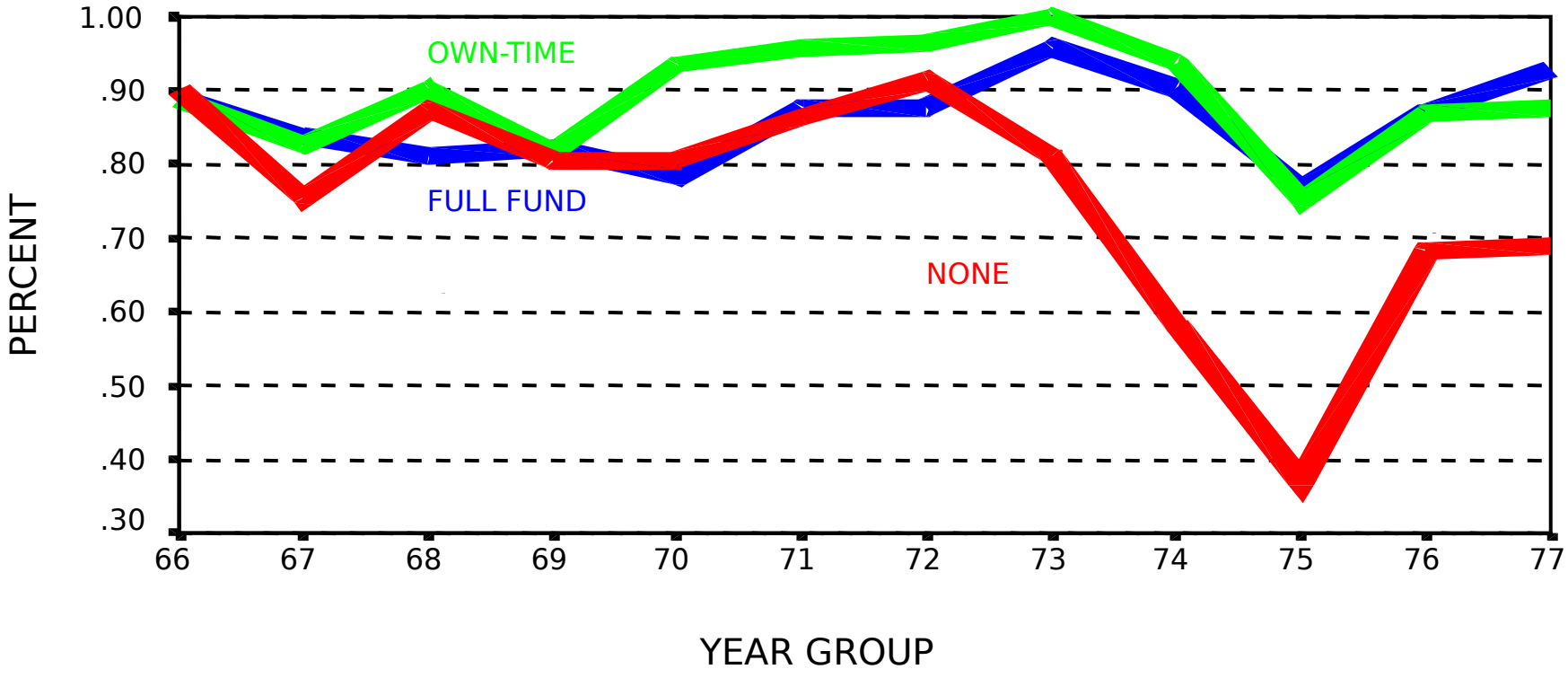


Retention Rate=Percent of LCDRS who stay to 05 Boards.

SWO PROMOTION RATES TO CDR BY GRADUATE DEGREE STATUS

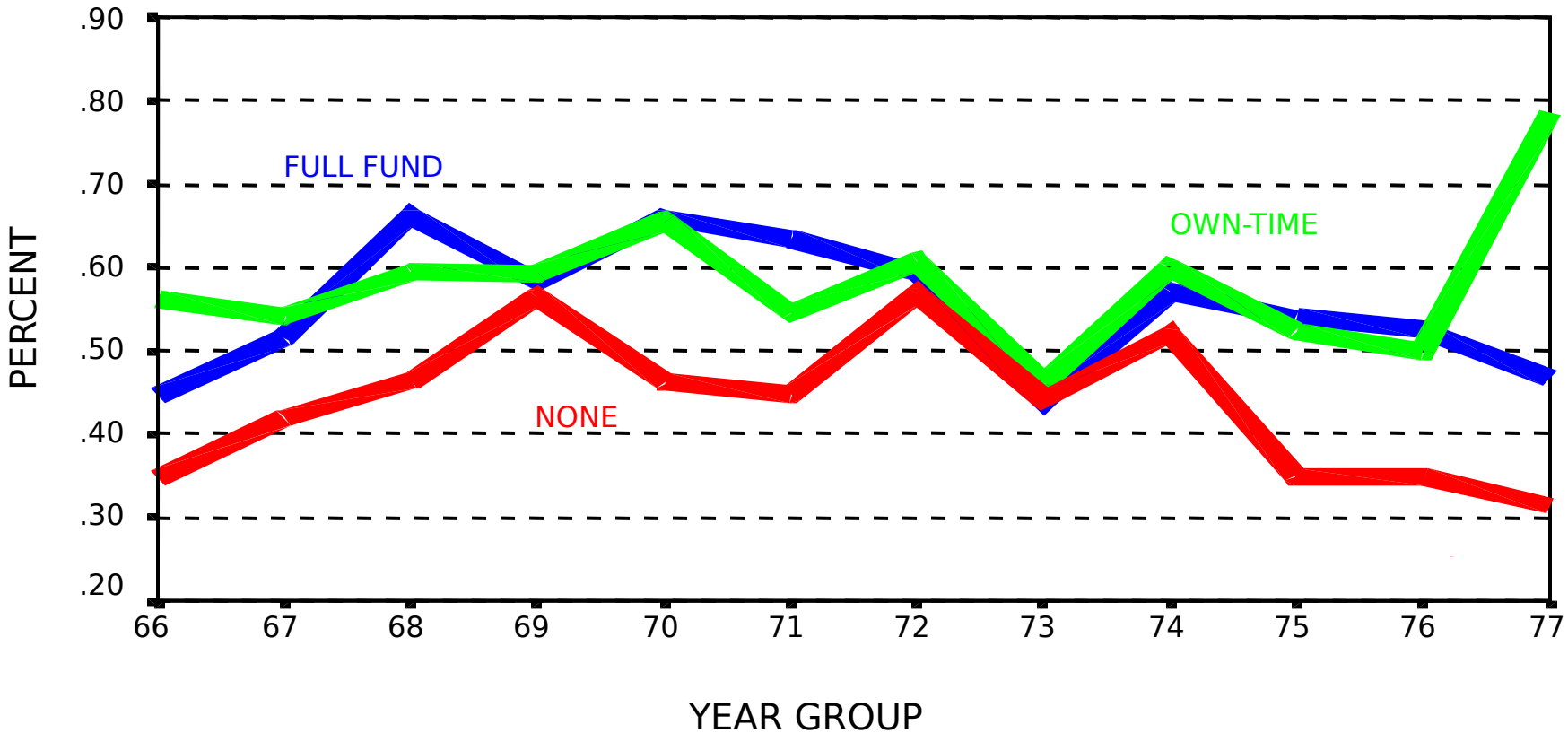


CDR RETENTION RATE TO 06 BOARD BY GRADUATE DEGREE STATUS



Retention Rate=Percent of CDRs who stay to 06 Board.

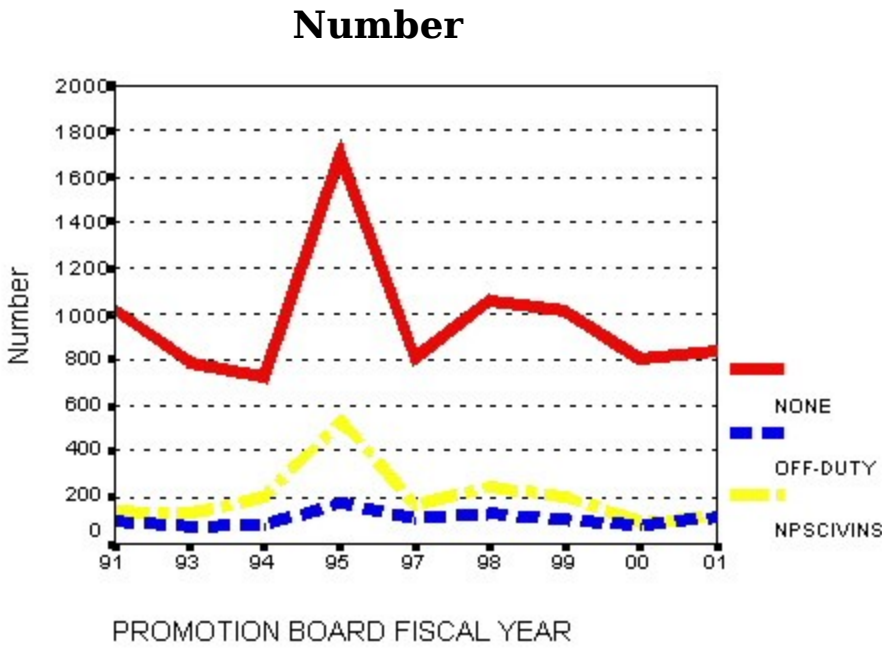
SWO PROMOTION RATE TO CAPTAIN BY GRADUATE DEGREE STATUS

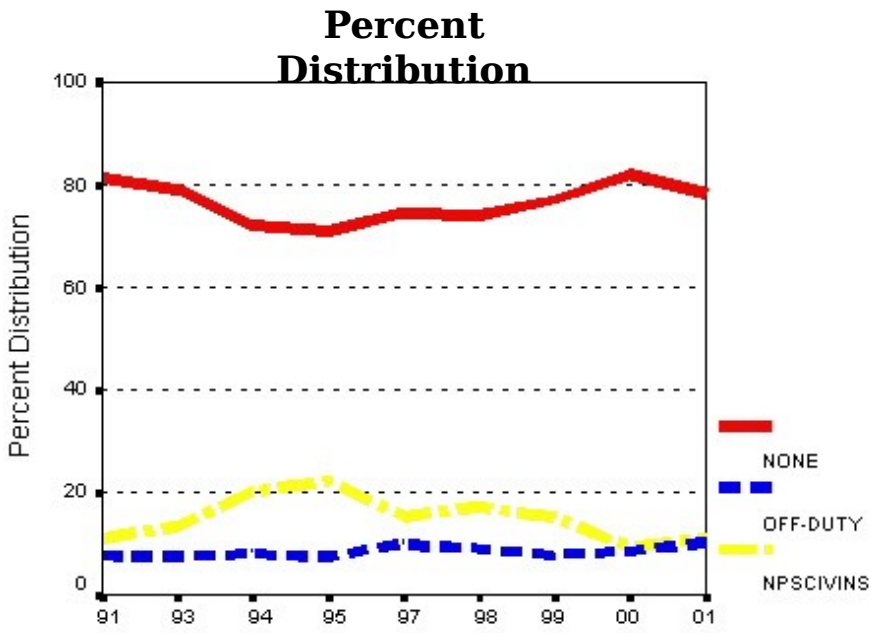


Calculating ROI

- ***Benefits*** **= present discounted value of program outcomes (e.g., retention) over a given future time period**
- ***Costs*** **= present value of program costs over a given future time period**
- ***Net benefits*** **= Present discounted value of benefits minus costs**
- ***Return on Investment*** **=**
  - **(Net Benefit/Costs) x 100**

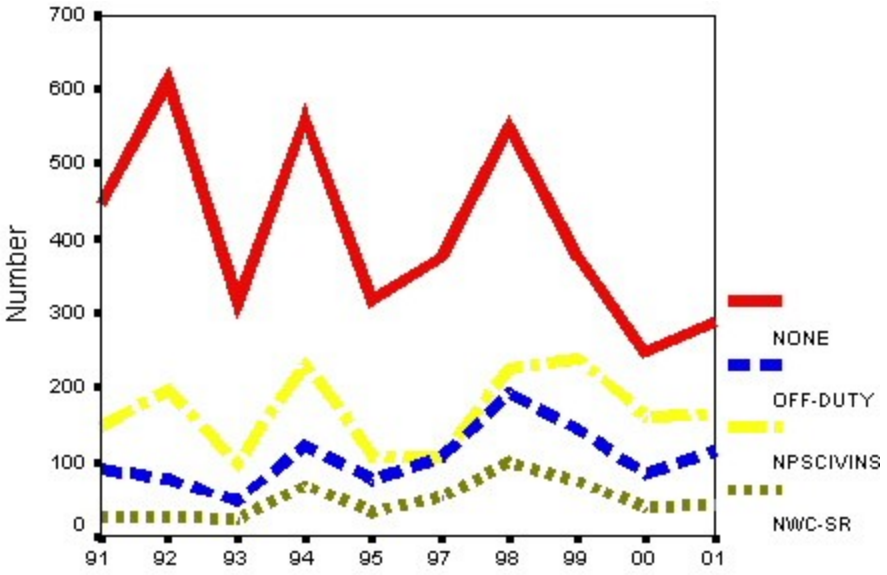
URL Officers At **LCDR Board** By Graduate Degree: FY1991-2001



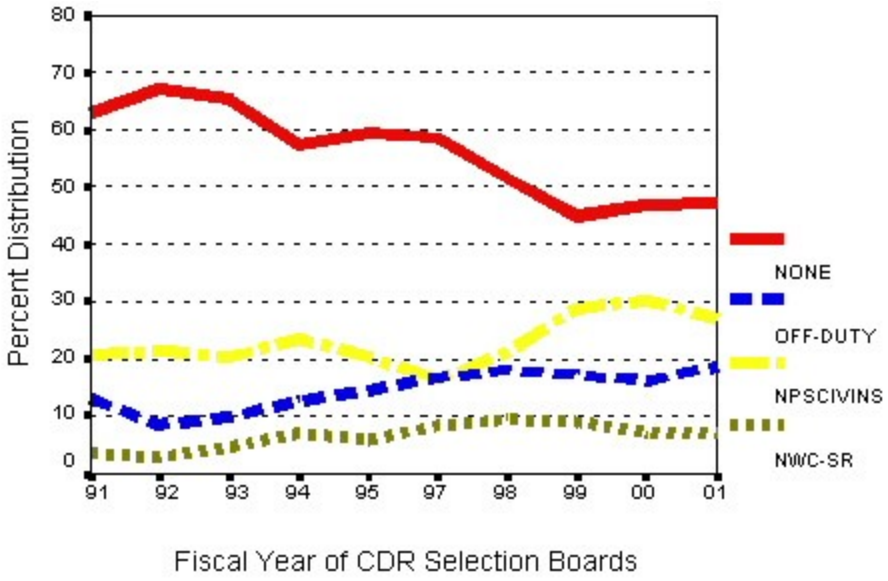


URL Officers at **CDR Board** By Graduate Degree: FY1991-2001

Number

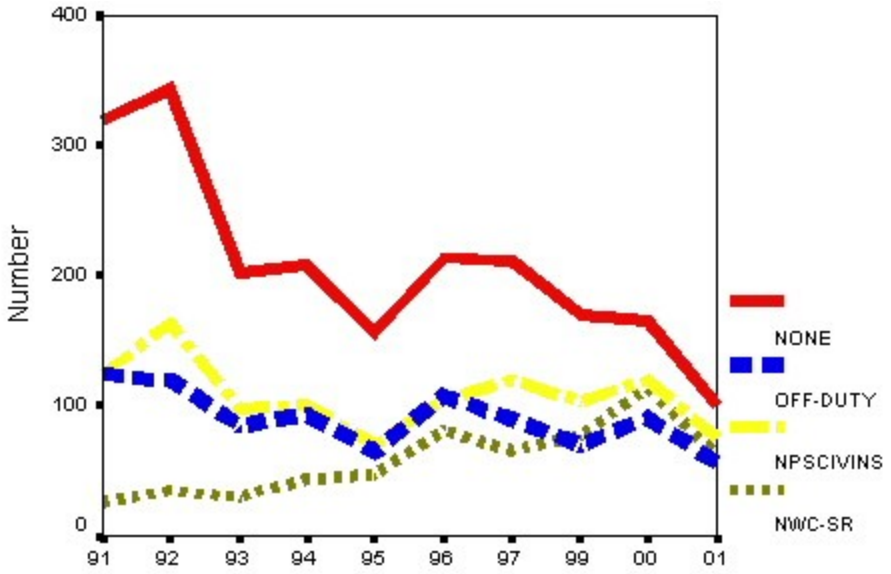


Percent Distribution

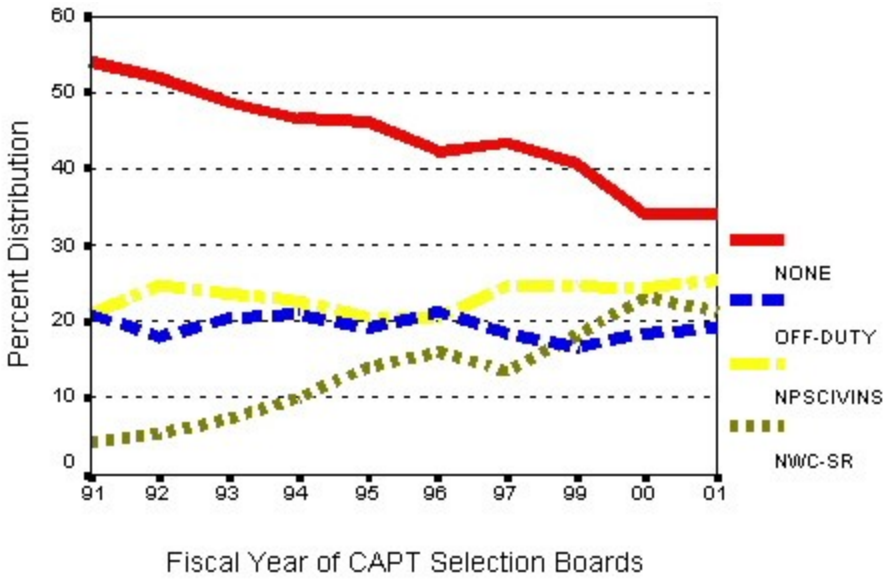


URL Officers at **CAPT Board** By Graduate Degree: FY1991-2001

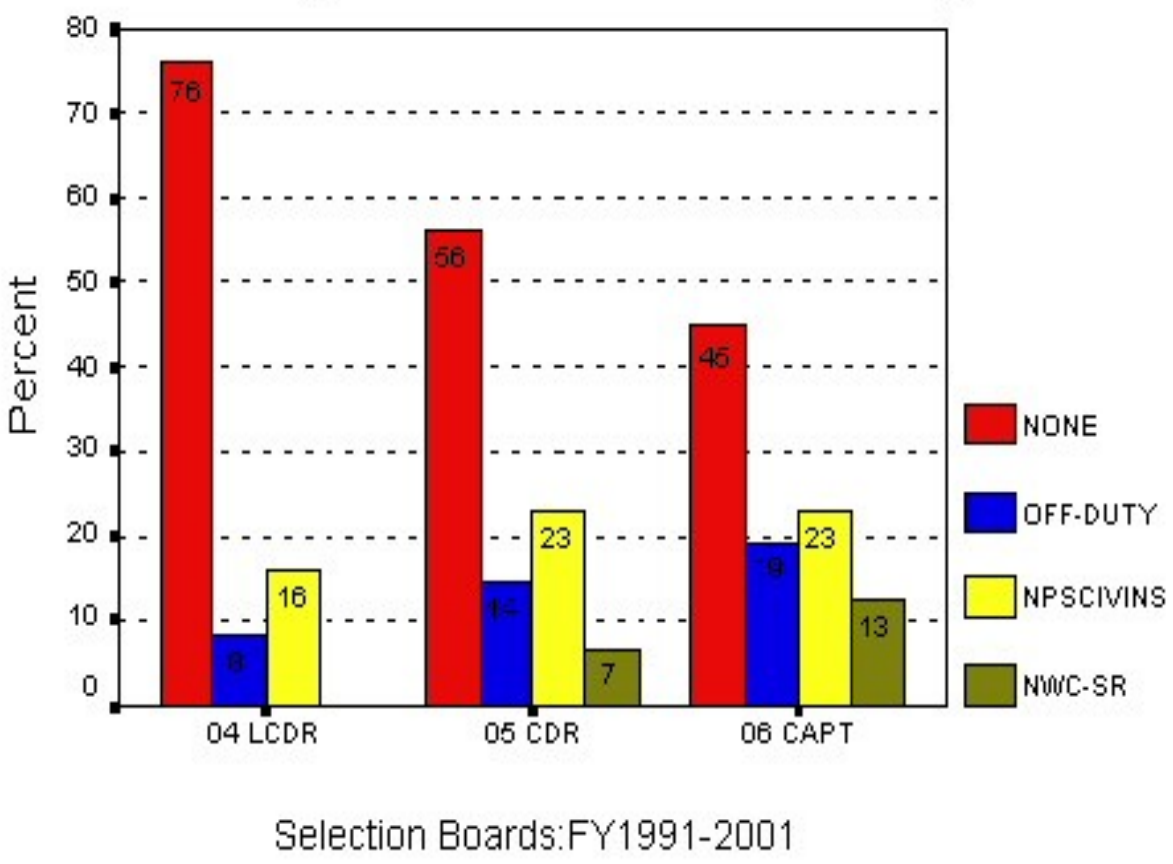
Number



Percent Distribution



Distribution of URL Officers at Selection Boards by Graduate Education Degree



URL Community Distribution of Officers by Graduate Degree: FY1991-2001